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EVALUATION OF AGRICULTURAL PESTS IN TUBER CROP PLANTATIONS IN MENOFIYA GOVERNORATE

Hussein, Abd-El-Khalek M. Mikhail, Wafai Z.A.
~~M. H. Abd-El-Khalek~~[1] and ~~Z. A. M. Wafai~~[2]
1- Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt
2- Department of Natural Resources, Institute of African Research & Studies, University of Cairo, Egypt

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ABSTRACT: *This study investigates soil mesofauna population in tuber field crops at Menofiya Governorate. Samples were collected during a period of one year (from December 1995 to November 1996) by means of the pitfall trap method. Data were statistically analyzed by the advanced multivariate statistical methods, correspondence analysis and ascending hierarchic classification. Obtained results show that herbivores are less in case of taro and sweet potato whereas the ant foraging activity is higher in the case of taro, since the two crops form a mosaic pattern of cultivations. Moreover, the host plant species architecture and leaf morphology were the possible cause affecting patterns of densities and distribution of both herbivores and carnivores. While distribution of detritivores is greatly affected by soil moisture and organic matter content.*
Key Words: Tuber crop, Herbivors, Carnivores, Detritivores, Mesofuna.

INTRODUCTION

The composition and diversity of soil animals may differ in agro-ecosystems according to cropping patterns and type (Perfecto and Sediles 1992), intensity of agricultural practices (Swift *et al.* 1996) and the complex influence of site and cultivation specific parameters (Mikhail and Hussein 1997). All these factors appear to create a rather accidental pattern of soil mesofauna frequencies in agro-ecosystems (Mikhail and Hussein 1997). These factors will also affect the densities and pattern of distribution of the trophic (functional) groups among soil animals.

The present work is the second of a series of an extensive study applied on different field crops during different seasons at the area of Menofiya Governorate in order to study the community structure of soil fauna under such field crops, and to monitor differences in numbers of species and of individuals owing to the type of cultivated crops and season of cultivation. The first study (Mikhail and Hussein 1997) was to investigate the activity density of soil mesofauna associated with

potato fields in Menoufiya Governorate. The aim of the present investigation is to evaluate the potential agricultural pests among soil fauna in the tuber field crops in the area around Shebein El-Kom town Menofiya Governorate.

MATERIAL AND METHODS

The study area and crops

The study comprises the investigation of activity density of total soil mesofauna as well as the main functional (trophic) groups; herbivores, detritivores and carnivores associated with tuber crop cultivations around the area of Shebein El-Kom town, Menoufiya Governorate. The tuber crops are: potato, sweet potato, taro, and carrot. The latter crop is classified as root crop, however, it was grouped with the tuber crops in the present study. This investigation was carried out during the period between: February and May 1996 for potato, between May and August 1996 for sweet potato, between December 1995 and August 1996 for taro, and between September and November 1996 for carrot. Normal agricultural practices were followed.

Method of sampling soil mesofauna

The soil mesofauna were collected from the study area by the pitfall trap method as described by Southwood (1978) and Slingsby and Cook (1986). In this method, the number of individuals trapped is primarily dependent on their locomotory activity (Greenslade and Greenslade 1983, Kromp 1990, Mikhail 1993). These are called activity densities rather than population densities (Kromp 1990, Mikhail 1993, Mikhail *et al.* 1995, Mikhail and Hussein 1997) and can not be related to the abundance per unit area (Kromp 1990) but are taken as number per trap (Mikhail 1993, Mikhail *et al.* 1995, Mikhail and Hussein 1997).

The number of pitfall traps used is varied according to the cultivation period of each crop. A total of 75, 55, 140 and 75 traps were used in the case of potato, sweet potato, taro and carrot, respectively.

Statistical analysis

Data of the activity density of the soil fauna were statistically analyzed by multivariate statistical methods: correspondence analysis CA (Greenacre 1984) and ascending hierarchic classification AHC (Roux 1985). The computer calculations for CA and AHC were carried out at University of Cairo using DATAVISION programme 1.2 (Roux 1987) developed for APPLE IIe in BASIC.

Results

Table (1) lists the species and/or higher taxa sampled during the present study. Total activity density (individuals/trap) is 188.98 for the whole study and for all crops. Potato fields support 29 species and/or higher taxa with total activity density of 37.05, sweet potato support 26 species and/or higher

taxa with total activity density of 93.45 (including 54.55 Formicidae), taro support 32 species and/or higher taxa with total activity density of 25.02 and carrot support 15 species and/or higher taxa with total activity of 33.46.

Fig. (1) shows results of the breakdown of soil mesofauna sampled during the present investigation into the three main trophic (functional) groups; herbivores, carnivores, and detritivores; under potato, sweet potato, taro, and carrot crops. High number of herbivores was associated with each of carrot and potato cultivations. The carnivore group of soil mesofauna was predominate in sweet potato and potato cultivations. On the other hand, the detritivore group of the soil mesofauna was generally lower in the four investigated crops. However, taro crop has the high number of the detritivore group (1.69 individuals/trap) among the four crops and each of potato and sweet potato has nearly same numbers (1.62 and 1.53), whereas carrot has the lower number (0.88).

Fig (2) shows results of the application of CA and AHC to the data of Table (1). Fifty two percent of the total variance is associated with the first (horizontal) axis and 37% with the second (vertical) one. The first axis separates sweet potato and carrot from each other indicating low affinity between the two crops. The other two crops, taro and potato, have high affinity between them. Sweet potato is characterized by Isopoda, *Pirates* spp., Scoliidae, *Polistes gallicus*, *Camponotus* spp., and Formicidae. Carrot is characterized by Collembola, *Gryllus domestica*, *Aphis* spp., *Gausopterus* spp., *Eristalis* spp., *Monomorium* spp., and Sphecidae. Taro and potato are characterized by 18 soil mesofauna taxa. These are: *Liogryllus bimaculatus*, *Chrysoperla carnea* (larva), *Pentodon bispinosus*, *Tropinota squalida*, *Medon ochracem*, *Phytonomus* spp., Lepidoptera (adult), *Pieris rapae*, *Syrphus corllae*, Muscidae, *Philianthus* spp., *Apis mellifera*, Apoidea, *Messor* spp., Earthworms, Millipeds, *Neomolgus aegyptiacus*, and *Anopheles* spp. A group consists of 6 taxa: *Chrotogonus homolobamus*, *Gryllotalpa gryllotalpa*, *Paederus alfierii*, *Drasterius bimaculatus*, Lepidoptera (larvae), and *Sarcophaga* spp. is associated with either the sweet potato or the group which contain taro and potato. Another group of soil mesofauna taxa being at the middle of the ordination graph and seems to be associated with all the studied crops. These are: *Labidura riparia*, *Pterostichus* spp., *Musca domestica*, and Spiders. *Aiolopus* spp. is not associated with any of the studied crops, however, it may be associated with the carrot group.

Discussion

Since agro-ecosystems differ in age, diversity, structure and management, there is great

Table (1) List of species and/or higher taxa sampled during the period between December 1995 and November 1996 under potato (P), sweet potato (SP), taro (T), and carrot (C).

Taxa	P	SP	T	C
Isopoda	1.15	11.10	1.50	1.20
Collembola	4.60	1.25	0.70	2.05
Orthoptera				
Acriididae				
Chrotogonus homolobamus	0.05	0.20	0.15	
Aiolopus spp.			0.05	1.14
Gryllotalpidae				
Gryllotalpa gryllotalpa	0.05	0.25	0.15	
Gryllidae				
Liogryllus bimaculatus		0.90	0.05	
Gryllus domestica		0.55	0.75	1.36
Dermaptera				
Labiduridae				
Labidura riparia		0.55	0.50	0.23
Homoptera				
Aphididae				
Aphis spp.	9.40	0.10	0.30	1.36
Neuroptera				
Chrysopidae				
Chrysoperla carnea (larva)	0.40			
Hemiptera				
Reduviidae				
Pirates spp.		0.20	0.04	
Coleoptera				
Scarabaeidae				
Pentodon bispinosus	0.35			
Tropinota squalida	0.20		0.25	
Carabidae				
Pterostichus spp.	0.65	2.20	0.95	0.68
Staphylinidae				
Medon ochracem	1.25	0.90	0.40	
Gausopterus spp.			0.04	0.11
Paederus alfierii		0.25	0.40	
Elateridae				
Drasterius bimaculatus	0.65	0.90	0.05	

Table (1) Cont.

Taxa	P	SP	T	C
Curculionidae				
Phytonomus spp.	0.05		0.35	
Lepidoptera (larvae)	0.35	0.35		
Lepidoptera (adult)	0.15		0.05	
Pieridae				
Pieris rapa	0.25		0.20	0.11
Diptera				
Syrphidae				
Syrphus corllae	2.60		1.55	
Eristalis spp.	0.05			0.11
Sarcophagidae				
Sarcophaga spp.	0.25	0.65	0.35	
Muscidae	0.40	0.55	0.95	
Musca domestica	0.80	1.55	0.95	0.68
Hymenoptera				
Scoliidae		0.35	0.04	
Sphecidae	0.45		0.10	0.57
Philianthus spp.	0.05			
Apoidea	0.40			
Apidae				
Apis mellifera	0.80	0.45	0.30	
Eumenidae				
Polistes gallicus		0.10		
Formicidae		54.55	0.20	1.93
Messor spp.		0.10	0.50	
Monomorium spp.	0.75	1.45	1.30	17.27
Camponotus spp.		1.65	0.20	
Spiders	9.65	10.90	8.70	4.66
Earthworms	0.05		3.00	
Millipedes	0.85	1.45		
Acarina				
Bdellidae				
Neomolgus aegyptiacus	0.40			

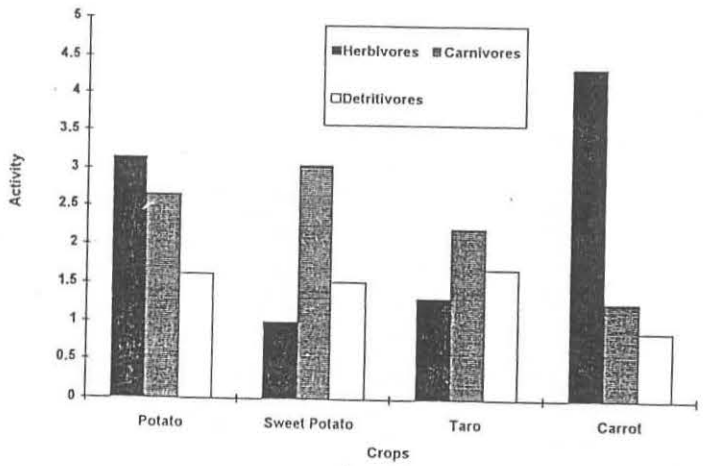

Fig (1) Variation in the trophic groups of soil mesofauna under potato, sweet potato, taro, and carrot crop cultivations.

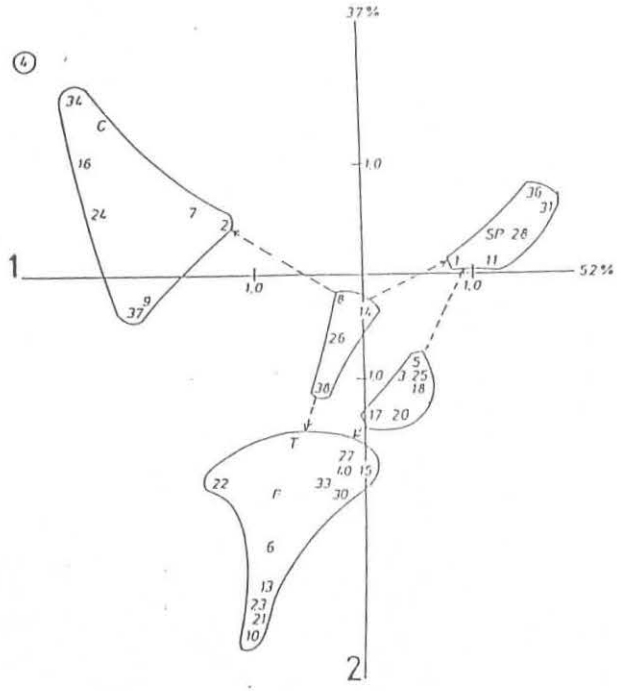

Fig. (2) Graphical representation of the application of CA and AHC methods to data of Table (1). Crops, P, potatoes; Sp, sweetpotatoes; T, taro; C, carrot. Species, numbers 1-52: 1, Isopoda; 2, Collembola; 3, *Chrotogonus homolobamus*; 4, *Aiolopus* spp.; 5, *Gryllotalpa gryllotalpa*; 6, *Liogryllus bimaculatus*; 7, *Gryllus domestica*; 8, *Labidura riparia*; 9, *Aphis* spp.; 10, *Chrysoperla carnea* (larva); 11, *Pirates* spp.; 12, *Pentodon bispinosus*; 13, *Tropinota squalida*; 14, *Pterostichus* spp.; 15, Carabidae; 16, *Medon ochracem*; 17, *Gausopterus* spp.; 18, *Paederus alfierii*; 19, *Drasterius bimaculatus*; 20, *Phytonomus* spp.; 21, Lepidoptera (larvae); 22, Lepidoptera (adult); 23, *Pieris rapa*; 24, *Syrphus corllae*; 25, *Eristalis* spp.; 26, *Sarcophaga* spp.; 27, *Musca domestica*; 28, Muscidae; 29, Scoliidae; 30, *Philianthus* spp.; 31, *Apis mellifera*; 32, *Polistes gallicus*; 33, Apoidea; 34, *Messor* spp.; 35, *Monomorium* spp.;36, *Camponotus* spp.; 37, Formicidae; 38, Sphecidae; 39, Spiders; 40, Earthworms; 41, Millipedes; 42, *Neomolgus aegyptiacus*. 28 superimposed 35; 6 superimposed 19; 13 superimposed 42; 10 superimposed 12, 29, 32, 39 and 41.

variability in basic ecological and agronomic patterns among different agro-ecosystems (Alteiri 1991). The composition and diversity of soil animals may differ in agro-ecosystems according to cropping patterns and type (Perfecto and Sediles 1992) and intensity of agricultural practices (Swift *et al.* 1997). In the present investigation, the type of crops cultivated differ. Taro, potatoes, sweet potatoes are tuber crops while carrot is a root one. This leads to marked difference in numbers of species and/or higher taxa sampled from the above mentioned crops. On the other hand, the intensity of agricultural practices being minimum in taro cultivation, medium in each of potato and sweetpotato cultivations, and maximum in the carrot cultivations. However, the taro crop receives surplus amounts of irrigation, since its water requirements are high and the cultivation period extends for about 11 months.

Ghabbour (1991) pointed out the importance of studying the trophic (functional) groups of the soil fauna populations in order to evaluate the structural composition of these groups in different ecosystems. In the present study, the trophic groups: herbivores (potential agricultural pests), carnivores (natural enemies of herbivores), and detritivores (essential of soil fertility) were well represented under all crops. These results suggest that the soil fauna of taro, potatoes, sweet potatoes and carrot cultivations has complex food chains (Mikhail and Hussein 1997). Perfecto and Sediles (1992) studied the effect of vegetational diversity on ants and herbivorous pests in a maize-bean biculture and maize monoculture in Nicaragua agro-ecosystems. They found that the abundance of herbivores on maize would be less in the biculture than in the monoculture and the ant foraging activity would be higher in biculture. In the present study, herbivores are less in the case of each of taro and sweet potato and the ant foraging activity is higher in the case of taro, since the two crops form a mosaic pattern of cultivations. This pattern is started when taro is cultivated with potatoes in adjacent fields. Herbivores are more abundant with potatoes and less abundant in the case of taro. When sweet potatoes were cultivated, the taro crop was grown enough and herbivores were less abundant in both crops. The carrot was cultivated after the harvest of the two mentioned crops and had a high abundance of herbivores. Aguilar and Boecklen (1992) found that the possible cause affecting patterns of herbivore densities and distribution were host architecture and leaf morphology. The leaf of each of taro and sweet potato is not attractive to herbivores while the leaf of each of potatoes and carrot is attractive.

The detritivores were less abundant in the present study when compared with the other two groups; herbivores and carnivores.

However, detritivores were abundant in taro cultivation due to the surplus amount of water used and subsequent increase in soil humidity as well as the higher availability of organic matter. The abundance of carnivores is medium when compared to the other two groups. The density and distribution of carnivores seem to be oppositely affected by the same factors which affect density and distribution of herbivores.

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تقييم الآفات الزراعية فى زراعات المحاصيل الدرنية بمحافظة المنوفية

عبد الخالق محمد حسين (١) ، وفائى زكى عازر ميخائيل (٢)

(١) معهد بحوث وقاية النبات – مركز البحوث الزراعية – الدقى – الجيزة

(٢) قسم الموارد الطبيعية – معهد البحوث والدراسات الأفريقية – جامعة القاهرة

الملخص العربى :

أجريت هذه الدراسة فى الحقول الزراعية حول مدينة شبين الكوم بمحافظة المنوفية وذلك خلال الفترة من ديسمبر ١٩٩٥ إلى أغسطس ١٩٩٦ ، وذلك لتقييم الآفات الزراعية و كثافة نشاط عشائر حيوانات التربة المصاحبة لزراعات المحاصيل الدرنية مثل البطاطس و البطاطا و القلقاس و الجزر ، كذلك اثر ها على الاتزان فيما بين المجموعات الوظيفية الثلاث : العاشبات الدقيقة الحجم (الآفات المحتملة) و آكلات النثار (المسئولة عن زيادة خصوبة التربة) و المفترسات (الأعداء الطبيعية للعاشبات). وقد جمعت حيوانات التربة بواسطة طريقة مصائد الحفر. عولجت النتائج إحصائيا بطرق التحليل الإحصائي المتعدد المتغيرات: التحليل التوافقى والتقسيم الهيراركى. أظهرت نتائج الدراسة أن عدد أنواع حيوانات التربة فى زراعات كل من القلقاس و البطاطس و البطاطا و الجزر هى ٣٢ و ٢٩ و ٢٦ و ١٥ نوعا على الترتيب وذلك خلال فترة الدراسة. و قد تبين أن العاشبات الدقيقة الحجم قليلة العدد في كل من القلقاس و البطاطا. كما يزداد نشاط النمل المصاحب لزراعات القلقاس. كذلك أظهرت هذه الدراسة أن كل من نوع المحصول و كذلك شكل الورقة هما من العوامل الهامة و المؤثرة على كثافة نشاط و توزيع كل من العاشبات الدقيقة الحجم و المفترسات، كما تبين أن آكلات النثار تتأثر إلى حد كبير بكل من نسبة الرطوبة و المادة العضوية في التربة.